DEPLOYMENT OF DATA SONDES FROM FISHING PIERS TO MONITOR NEARSHORE HYPOXIA IN LONG BAY, SOUTH CAROLINA

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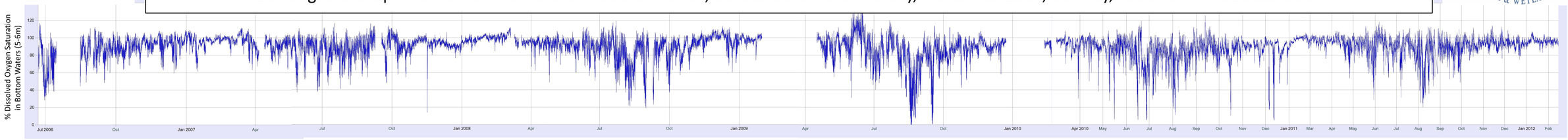


Hypoxia Discovered in Long Bay, SC

- Long Bay is a shallow coastal embayment bounded in the North by the Cape Fear River and in the south by Winyah Bay (Figure 1).
- The Grand Strand covers 57 km of Long Bay's coastline and houses beachfront tourist destinations such as Myrtle Beach.
- The Grand Strand collectively hosts 15 million visitors per year and hence has become highly urbanized.

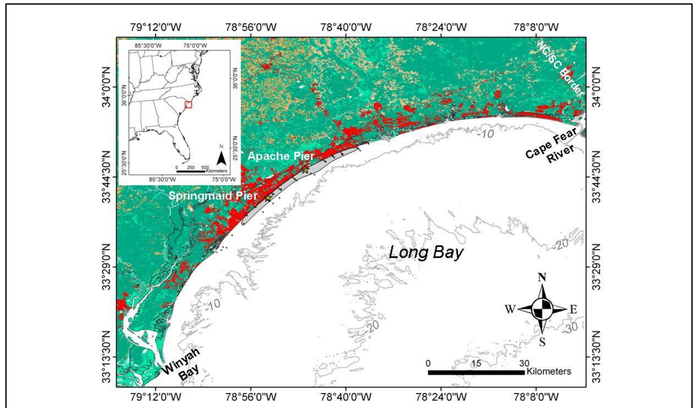


Fig. 1. Long Bay lies on the inner continental shelf of the South Atlantic Bight of the USA. The general area over which hypoxia is being observed is shaded in gray. Developed lands are shown in red, forested and wetlands in green and agricultural lands in orange (NOAA Coastal Change Analysis Program 2005). Bathymetric data: NOAA Geophysical Data Center.

- Dissolved oxygen levels were not being monitored in Long Bay at the time that hypoxic conditions were first discovered.
- Hypoxic conditions were first discovered in July 2004 during a flounder jubilee (Figure 2).
- A monitoring program was initiated in 2006 at the seaward ends of two fishing piers that project about 1000 feet offshore.

Fig. 2. Local press coverage of hypoxia in Long Bay and impact on recreational fisheries

Monitoring Program

- Surface and bottom monitoring of dissolved oxygen, salinity and temperature began in 2006 at the Apache and Springmaid fishing piers (Figure 3) .
- Data reported every 15 min to online data portal.
- Waters are generally undersaturated with respect to DO during summer months (Figure 4)
- Anoxic conditions were observed in Aug and Sept 2009 (Figure 5).

YSI Datasonde

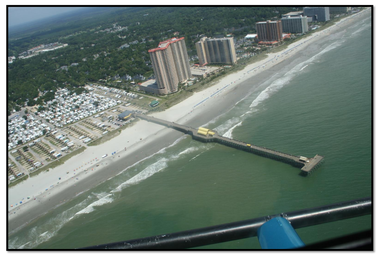


Fig. 3. Apache Family Campground Fishing Pier

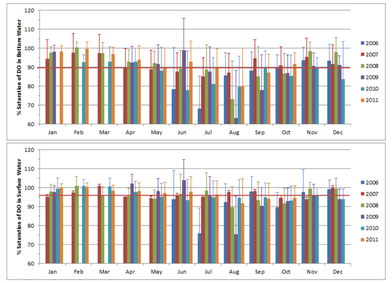


Fig. 4. Monthly mean percent saturation of dissolved oxygen at Apache pier. Red line marks overall mean values.

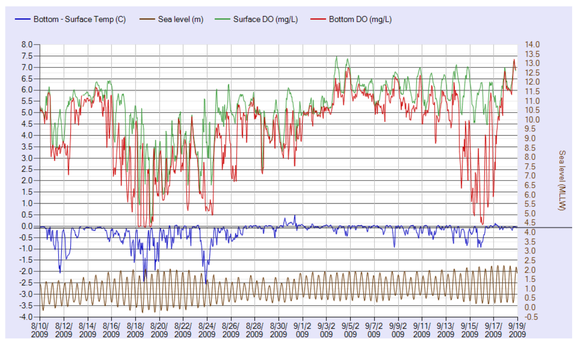


Fig. 5. Water quality sonde continuous data from Apache Pier documenting two periods of anoxia during Aug and Jul 2009.

- Both events occurred on spring tides following periods of upwelling favorable winds (out of the southwest.)
- Modest degree of stable vertical temperature stratification was present.
- Lowest DO coincided with flooding tides.

Constrained mixing hypothesis for the formation of hypoxia in Long Bay

Terrestrial inputs (nutrients & organic matter)
- **Outfall pipes, swashes, ocean outfalls**
- **Rivers, inlets, groundwater**

Non-hypoxic conditions
- **Local inputs widely dispersed in coastal ocean**
- **Low concentration = Low DO consumption rates**

Hypoxic conditions
- **Southwest winds cause upwelling of bottom water**
- **Bottom water intrusion acts as a physical barrier preventing dispersion of inputs**
- **Inputs concentrate inshore**
- **Elevated concentrations greatly stimulate DO consumption rates leading to localized hypoxia**

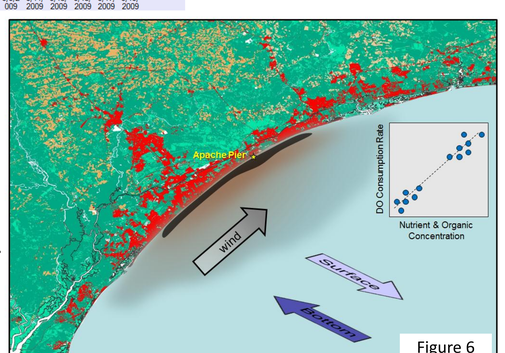


Figure 6

Novel Deployment of Monitoring Gear

- YSI 600 OMS and 6600 EDS data sondes deployed on stainless steel ziplines in water depths of 5 to 7 m in nearshore just seawater of surf zone
- Surface sonde maintained ~1m below the surface using counterweights
- Bottom sonde ~1m above the bottom
- Vaisala WXT520 weather station
- Lightening protection includes pom-pom diffusers.
- Data transmitted every 15 min to YSI Econet for display on public web portal http://www.ysieconet.com/public/WebUI/Default.aspx?hidCustomerID=131
- Biofouling requires cleaning 3 times a week during summer months.
- Field QC includes pre and post deployment comparison with manually deployed sonde. In-situ accuracy ± 0.4 mg/L for DO and ±0.25 psu for salinity
- Secchi depths also measured.
- Data QC'd using Aquarius software from Aquatic Informatics

Weather station and pom-pom diffusers

Counter-weighting

YSI Econet uses cell modem

Expansion of Monitoring Network in 2012

- Newly formed Long Bay Hypoxia Monitoring Consortium
- Funded monitoring at Cherry Grove (North Myrtle Beach),and Second Avenue (Myrtle Beach) piers
- Adds turbidity, pH and chlorophyll sensors
- Funds ,radon (Rn-222) detectors in bottom water to document constrained mixing and groundwater inputs to Long Bay.
- Funds larval recruitment study to document effects of low DO on biota.

Radon-222 detector on pier deck. Bottom water is pumped to the detector.

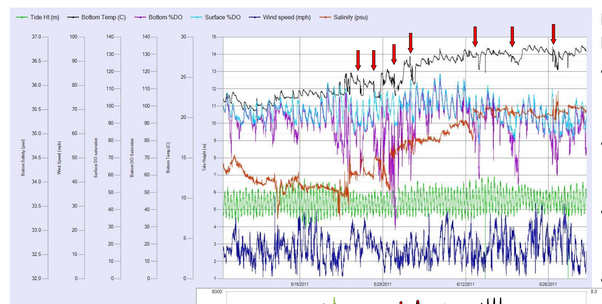
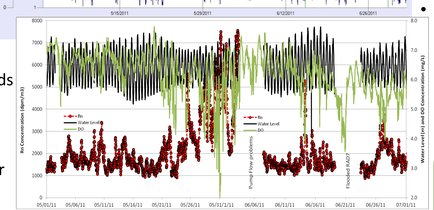


Figure 8. Low DO events in May 2011

- Red arrows mark periods of low temperature and concurrent low DO
- Wind speeds were below 10 mph during each of these events.
- Wind direction was upwelling favorable preceding these events.
- Lowest DO was observed during flooding tides.

Low DO events occur as abrupt transitions suggesting advection of low DO water masses past the sondes.

- Radon-222 levels increase during periods of low DO
- Supports constrained mixing hypothesis
- Suggests groundwater inputs are significant.



Rn data provided by Dr. R. Peterson, CCU

Long Bay Hypoxia Monitoring Consortium and financial supporters